

**REMARKS**

Claims 1, 2, 5-9 and 12-14 are currently pending in this application. Claims 1 and 2 have been amended. Claims 3 and 4 have been canceled and the subject matter incorporated into claim 2. Claims 10 and 11 have been canceled. Support for all amendments to the claims can be found in the specification and drawings as originally filed.

Claims 1-4 stand rejected under 35 U.S.C. §112, second paragraph, for indefiniteness.

The Examiner requires clarification of the two shrinkage factors ( $X_v$  and  $X_s$ ) with respect to claim 1. Applicants have amended claim 1 to define " $X_v$ " as the firing shrinkage factor of the through-hole for via hole formation and " $X_s$ " as the firing shrinkage factor of the aluminum nitride molding.

The Examiner indicates that the terms "highly isolated" and "densely present" in claim 2 and the terms "volume sum" and "whole volume" in claims 3 and 4 are unclear. The subject matter of claims 3 and 4 have been incorporated into claim 2 and independent claim 2 has been rewritten to address the §112 rejections. Reconsideration of the rejection of claims 1-4 is respectfully requested.

Claims 1-6 and 9-12 stand rejected under 35 U.S.C. §103(a) for obviousness over JP 10-107437 (hereinafter "JP '437") or JP 2986596 (hereinafter "JP '596").

Amended independent claim 1 is directed to a process for producing a sintered aluminum nitride furnished with via holes. Independent claim 1 requires aluminum nitride molding having through-holes for via hole formation and through-holes for formation of dummy via holes not used for electrical connection. The through-holes for formation of dummy via holes are distributed within the molding. The through-holes for via hole formation and the through-holes for dummy via hole formation are filled with a conductive paste, and the aluminum nitride molding and conductive paste are fired. The difference in a firing shrinkage factor of the through-hole for via hole formation,  $X_v$ , and a firing shrinkage factor of the aluminum nitride molding,  $X_s$ , is in the range of -1.0 to 9.5%.

Amended independent claim 2 is directed to a process for producing a sintered aluminum nitride furnished with via holes. Independent claim 2 requires an aluminum nitride molding having through-holes for via hole formation and through-holes for formation of dummy via holes not used for electrical connection. The through-holes for formation of

dummy via holes are distributed within the molding. The through-holes for via hole formation and the through-holes for dummy via hole formation are filled with a conductive paste and the aluminum nitride molding and conductive paste are fired. At least one of the through-holes for via hole formation is in a highly isolated state and includes other through holes for via hole formation and dummy via holes. At least one of the dummy via holes is formed around the through-hole for via hole formation in the highly isolated state. The through-hole for via hole formation in the highly isolated state has a volume of 0.9% or less of the other through-holes for via hole formation and also has a volume of 1-6% of the other through-holes for via hole formation and through-holes for dummy via hole formation in an area of a 5.0 mm radius from a center of the through hole for via hole formation in the highly isolated state.

JP '437 discloses a method of manufacturing a circuit board that prevents curvature deformation in the resultant calcined circuit board. The method includes laminating a plurality of glass-ceramic sheets, calcining the laminate and separating a trimmed edge region having dummy viahole conductors from the circuit board.

JP '596 discloses a method of manufacturing a ceramic board with through-holes. The process includes providing through-holes on a green sheet and forming dummy through-holes in the periphery of the holes, filling the holes with a paste of essentially tungsten, providing a layer of a substance capable of capturing carbon for converting the exposed paste and sintering the green sheet.

The Examiner states that JP '437 and JP '596 teach forming a ceramic board with through-holes and dummy holes as in the present invention. Applicants respectfully disagree. Neither JP '437 nor JP '596 teaches or suggests an aluminum nitride molding having an arrangement of through-holes for via hole formation of dummy via holes distributed within an aluminum nitride molding as in amended independent claims 1 and 2. For the Examiner's convenience, Applicants will herein refer to the through-holes for via hole formation in the present invention as "via holes" and the through-holes for formation of dummy via holes in the present invention as "dummy holes" for the remainder of the Amendment.

JP '437 discloses a plurality of glass-ceramic sheets with a trimmed edge region (102) having dummy viaholes (103) and located along a periphery of a circuit board region as illustrated in Figure 3 of JP '437. JP '437 does not teach or suggest the distribution of "dummy holes" within an aluminum nitride molding as in amended independent claims 1 and 2. JP '437 teaches dummy holes located around an edge of a board and not located within or throughout the molding. In addition to failing to teach the distribution of "dummy holes", JP '437 does not teach or suggest an aluminum nitride molding, but is directed to glass-ceramic sheets. Furthermore, the dummy viaholes formed on the periphery of the board in JP '437 are utilized to suppress the curvature deformation of the surface of a laminate to provide reliable mounting of IC chips on circuit boards. The "dummy holes" in amended independent claims 1 and 2 are distributed within the molding so as to prevent internal cracking within the board and therefore solves a different problem.

Moreover, JP '437 does not teach or suggest a firing shrinkage factor difference of  $-1.0$  to  $9.5\%$  between the "via hole" ( $X_v$ ) and the aluminum nitride molding ( $X_s$ ) as in amended independent claim 1. A firing shrinkage factor of  $-1.0$  to  $9.5\%$  results in sintered aluminum nitride void of internal cracking and poor densification. Furthermore, it is the distribution of the dummy holes in the molding that achieves a difference in shrinkage factors  $-1.0$  to  $9.5\%$  to avoid internal cracking within the molding.

JP '596 also does not teach or suggest an aluminum nitride molding having an arrangement of "dummy holes" distributed within the molding as in amended independent claims 1 and 2. JP '596 teaches the formation of dummy holes disposed only in the periphery of the through-holes and not within or throughout an inside region of the molding. Additionally, the dummy holes of JP '596 function to capture carbon which enters from the periphery of the green sheet and does not avoid internal cracking of the molding as in the present invention. For the foregoing reasons set forth above, reconsideration of the rejection of amended independent claim 1 with respect to JP '437 or JP '596 is respectfully requested.

Claims 5 and 6 depend from and add further limitations to amended independent claim 1 and are deemed to distinguish over the cited prior art and for the reasons discussed previously in connection with amended independent claim 1. Reconsideration of the rejection of claims 5 and 6 is respectfully requested.

In addition to failing to teach or suggest dummy holes distributed within the mold, neither JP '437 nor JP '596 teaches or suggests at least one "via hole" in a highly isolated state having a volume of 0.9% or less of via holes or a volume of 1-6% of "via holes" and "dummy holes" in a volume of a 5.0 mm radius area from a center of a "via hole" in a highly isolated state as in amended independent claim 2. Reconsideration of the rejection of amended independent claim 2 is respectfully requested.

Additionally, JP '437 does not teach or suggest a firing temperature of 1200-1700°C or 1800-1950°C. Rather, JP '437 discloses a calcination temperature of 800-1050°C. While such a temperature would allow deformation of a free edge of the peripheral portion of the substrate, it would not prevent cracking within the substrate and densification of the via holes as in the presently claimed invention.

Claims 9-12 depend from and add further limitations to amended independent claim 2 and distinguish over the cited prior art for the reasons discussed previously in connection with amended independent claim 2. Reconsideration of the rejection of claims 9-12 is respectfully requested.

Claim 7-8 and 13-14 stand rejected under 35 U.S.C. §103(a) for obviousness over JP '437 or JP '596 in combination with U.S. Patent No. 6,475,924 to Yamamoto et al. ("Yamamoto").

Yamamoto discloses a process for producing a substrate of an AlN sintered product having a via-hole conductor. The process includes the steps of filling the through-holes, dewaxing the AlN molded article and two-step firing the molded article.

Yamamoto does not teach or suggest, alone or in combination with JP '437 or JP '596, an arrangement of dummy holes distributed in the molding as in amended independent claims 1 and 2.

Claims 7-8 depend from and add further limitations to independent claim 1 and claims 13-14 depend from and add further limitations to independent claim 2 and are believed to be allowable for the same reasons discussed previously with respect to amended independent claims 1 and 2. Reconsideration of the rejection of dependent claims 7-8 and 13-14 is respectfully requested.

Claims 1-14 stand rejected under 35 U.S.C. §103(a) for obviousness over Yamamoto in combination with JP '437 or JP '596.

For the foregoing reasons set forth previously, Yamamoto does not cure the deficiencies of JP '437 or JP '596 with respect to amended independent claims 1 and 2. Reconsideration of the rejection of amended independent claims 1 and 2 is respectfully requested.

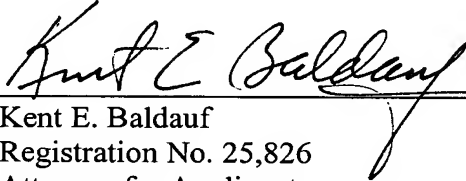
Claims 5 - 8 depend from and add further limitations to amended independent claim 1 and distinguish over the cited prior art for the reasons discussed previously in connection with amended independent claim 1. Reconsideration of the rejection of claims 5-8 is respectfully requested.

Claims 9 and 12-14 depend from and add further limitations to amended independent claim 2 and distinguish over the cited prior art for the reasons discussed previously in connection with amended independent claim 2. Reconsideration of the rejection of claims 9 and 12-4 is respectfully requested.

In view of the foregoing amendments and remarks, Applicants believe that claims 1, 2, 5-9 and 12-14 are in condition for allowance. Reconsideration of the Examiner's rejections and allowance of pending claims 1, 2, 5-9 and 12-14 are respectfully requested.

Respectfully submitted,

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